

TurboStart[®]

BATTERIES

SMARTCHARGER

12V/14V/16V

AGM BATTERY CHARGER

SMARTprocessor Controlled Multi-Stage
12V/14V/16V Charger
P/N CHG25A / CHG25AE

USER GUIDE



TurboStart SMARTCHARGER

USER GUIDE

About TurboStart

TurboStart designs and produces performance energy solutions for performance vehicles. Whether it's a daily driven hot rod, custom street rod, or an all out on road or off road race vehicle, TurboStart has the battery, charger, and accessories to best solve your vehicles energy needs.

Trademarks

Trademarks, registered trademarks, and product names are the property of their respective owners and are used herein for identification purposes only.

Notice of Copyright

SMARTCHARGER User Guide © January 2006-2016 by TurboStart. All rights reserved.

Disclaimer

UNLESS SPECIFICALLY AGREED TO IN WRITING, TurboStart:

(A) MAKES NO WARRANTY AS TO THE ACCURACY, SUFFICIENCY, OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN ITS MANUALS OR OTHER DOCUMENTATION.

(B) ASSUMES NO RESPONSIBILITY OR LIABILITY FOR LOSS OR DAMAGE, WHETHER DIRECT, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL, WHICH MIGHT ARISE OUT OF THE USE OF SUCH INFORMATION. THE USE OF ANY SUCH INFORMATION WILL BE ENTIRELY AT THE USER'S RISK.

The following conventions are used in this guide.

WARNING

Warnings identify conditions that could result in personal injury or loss of life.

CAUTION

Cautions identify conditions or practices that could result in damage to the charger or battery.

***Important*:** These notes describe an important item that you must pay attention to.

Chapter 1, Safety and Precautions	p. 1-2
Chapter 1 covers safety guidelines and precautions for using your SMARTCHARGER .	
Chapter 2, Features and Functions	p. 3-4
Chapter 2 explains the features, functions, specs, and benefits of the SMARTCHARGER .	
Chapter 3, Operations	p. 5-7
Chapter 3 explains the switches and indicators on the front panel of your SMARTCHARGER , including step by step instructions to correctly charge a performance battery.	
Chapter 4, Troubleshooting	p. 8
Chapter 4 will help identify and correct common issues that may occur with your SMARTCHARGER .	
FAQs	p. 9-10
Warranty	p. 11
Customer Info.....	p. 12
Contact Information	p. 12

Precautions Working With Lead-Acid Batteries

Follow all instructions published by the battery manufacturer and the manufacturer of the equipment in which the battery is installed.

- 1)** Make sure the area around the battery is well ventilated.
- 2)** Never smoke or allow a spark or flame near the battery(ies).
- 3)** Use caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and thereby cause an explosion.
- 4)** Remove all metal items, like rings, bracelets, and watches when working with lead-acid batteries. Lead-acid batteries produce a short circuit current high enough to cause a severe burn.
- 5)** Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
- 6)** Wear complete eye protection and clothing protection. Avoid touching eyes while working near batteries.
- 7)** If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood it with running cold water for at least twenty minutes and get medical attention immediately.
- 8)** If you need to remove a battery, always remove the ground terminal from the battery first. Make sure all accessories are off to minimize the potential of a spark.
- 9)** Someone should be in the range of your voice or close enough to come to your aid when working with a lead-acid battery.
- 10)** Do not attempt to remove the vent covers on sealed lead-acid batteries such as the TurboStart 16V AGM battery. Sealed batteries operate on a slight positive cell pressure. Venting this pressure will ruin the battery.

Important Safety Instructions

SMARTCHARGER generate a low DC voltage and high DC current to the battery being charged. Improper operation of the charger or misuse of the charger may cause damage to the charger or create hazardous conditions for the user.

⚠ WARNING: Explosion hazard

SMARTCHARGER are designed to charge 12V/14V/16V lead-acid batteries of all types. Do not attempt to use with batteries with voltages not matching the chargers specified voltage.

- Do not use this product where there are flammable fumes or gases.
- Do not use this product in an enclosure containing lead-acid batteries. These batteries vent explosive hydrogen gas, which can be ignited by sparks from electrical connections.
- Never attempt to charge a frozen battery.
- Do not connect DC clamps to the carburetor, fuel lines, or sheet metal body parts.

⚠ WARNING: Shock hazard. Keep away from children.

- Do not expose charger to water/rain or temperatures over 104 °F (40 °C).
- Do not open the charger. There are no user serviceable parts inside the unit. For service see the Returns policy in the back of this guide.
- Be sure AC and DC cords are not pinched or otherwise damaged by hoods, doors, or other moving engine components.
- Observe battery polarity.

IMPORTANT: If this charger is to be used with a portable generator, it should be equipped with automatic voltage regulation to ensure consistent output of the product.

⚠ WARNING: Heated surface-Ensure at least 2" (5 cm) air space is maintained on all sides of the charger.

⚠ CAUTION

An extension cord should not be used unless absolutely necessary. Do not use this product with an ungrounded extension cord. Use of an undersized extension cord will adversely affect the output of the product and could prove to be dangerous. If an extension cord must be used, make sure that pins on the plug of the extension cord are the same number, size and shape as those of the plug on the charger. TurboStart Batteries recommend a minimum of a 16AWG cord for lengths up to 50' and a minimum of a 14AWG cord for lengths up to 100'. We do not recommend cords over 100'.

SMARTCHARGERS are a group of advanced battery chargers designed specifically for high performance 12V/14V/16V sealed lead-acid batteries. **SMARTCHARGERS** combine the reliability of a HFM rectified assembly with a **SMARTprocessor** control board to create a battery charger that can rapidly and safely recharge 12V/14V/16V maintenance free, deep cycle, gel-cell, and AGM (Absorbed Glass Mat) batteries in several sizes.

Multi-Stage Charging

Smart charging is the brains behind the chargers multi-step system. During the Stage 1, "Bulk" charging, the current is fixed and the voltage is allowed to float. During this stage, 80% of the battery's capacity is restored.

When the battery's cell voltage is up to the correct level Stage 2, "Absorption" charging, is applied. In Stage 2 the battery will be charged to 100%. During Stage 3, "Float" charging, the voltage and current are reduced to a level that will maintain the battery indefinitely.

SMARTprocessor are used to tightly control the entire process. This is the same technique that battery manufacturers recommend and use in the production of new batteries and it is the fastest and safest technique for battery charging.

Compatible With All 12V, 14V & 16V AGM and Gel-Cell Batteries

SMARTCHARGERS are compatible with most LEAD ACID rechargeable Batteries Including AGM, deep cycle, and gel-cell.

Lead-acid batteries have different charging requirements based on their specific design. Overcharging will reduce the life of any battery as sealed valve regulated batteries are especially sensitive to high charging voltages and overcharging.

Overcharging an AGM or gel-cell battery will cause permanent damage.

Output Display

The **SMARTCHARGER** features a digital output display allowing the user to monitor the volt and amps.

Voltage Monitoring

The voltage is measured every five minutes at the battery's terminals by the on-board **SMARTprocessor** and this information is used by the **SMARTCHARGER** to control the battery charging for optimum charging performance.

Automatic Computer Analysis/Auto Shutdown

The microprocessors will analyze the battery when connected. If the battery's voltage is below 4V or the battery will not come up to the correct voltage in a ten-hour period the charger will automatically shut off.

Internal Cooling Fan

A cooling fan automatically operates during charging to keep the circuit and other internal components at a constant safe temperature.

Physical Specifications

- Dimensions 8 5/8" W x 7" H x 11 1/8" D
- Weight 24 lbs (10.87 kg)
- AC Input Connections 5.0' (1.5 m) AWG 16
- DC Output Connections 6.0' (1.8 m) AWG 10

Electrical Specifications

- | | <u>12V</u> | <u>14V</u> | <u>16V</u> |
|----------------------------------|------------|------------|------------|
| - Absorption Voltage | 14.40 VDC | 16.80 VDC | 19.20 VDC |
| - Float Voltage at no Load | 13.56 VDC | 15.82 VDC | 18.08 VDC |
| - Maximum Output Voltage | 14.40 VDC | 16.80 VDC | 19.20 VDC |

AC Input Specifications

- AC Input Voltage 120VAC, 50/60Hz or 230VAC, 50/60Hz
- AC Input Current 10A RMS fuse protected

Important: Specifications are subject to change without notice.

SMARTCHARGERS charge batteries in what is known as the multi-stage charging sequence. The charging voltage delivered to the battery depends on the battery's depth of discharge.

The 3 stages are:

- Stage 1 - Bulk
- Stage 2 - Absorption/Equalization
- Stage 3 - Float

Stage 1 / Bulk Charge

In Stage 1 / Bulk charging the **SMARTCHARGER** delivers its full-rated output current. This constant current is delivered to the batteries until the battery voltage approaches its absorption voltage, either 2.5V per cell or 2.375V per cell depending on battery type selected. Stage 1 / bulk charge restores about 75% of the battery's charge and this stage is completed very quickly unless the battery is deeply discharged. During this stage the charge rate current on the ammeter should close to the charge rate selected on the front panel switch.

Stage 2 / Absorption Charge

During the Stage 2 / Absorption charging the charging voltage is held constant near the gassing voltage, and the charging current is allowed to diminish as the battery comes up to 100% charge. Complex algorithms considering the time, voltage level, and charging current determine when the charger exits this stage and goes to the final stage, Stage 3 / Float charging. The length of time of this stage depends on the battery and is not fixed.

Stage 3 / Float Charge

Stage 3 / Float charging is a maintenance phase in which the output voltage of the charger is reduced to a lower level, typically about 2.26 V per cell to maintain the battery's charge without losing electrolyte through gassing. In the Stage 3 / float charge, the charger will initiate a new charge cycle if:

- AC power is disconnected and reconnected
- The current demand on the **SMARTCHARGER** exceeds the battery recharge current setting.

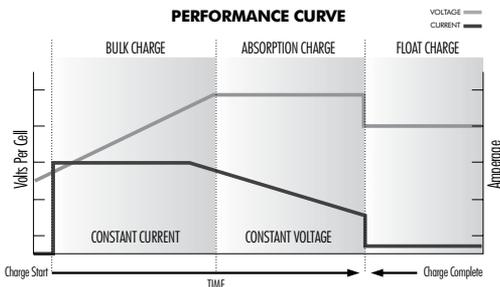


Figure B-1 Three-stage charging profile

Charging Lead-Acid Batteries

⚠ WARNING: Before you start to charge batteries read the “Important Safety Instructions” on page and take all safety precautions when working with batteries.

SMARTCHARGER have been designed to provide fully automatic recharge most 12V/14V/16V AGM and gel-cell batteries.

To charge your 12V, 14V or 16V battery:

1) If possible, disconnect all loads from the battery, by removing battery cables, opening a disconnect switch, or switching loads off.

⚠ CAUTION!

Although this is best, in a racing environment this may not be possible. Supplemental loads such as an electric water pump or cooling fans may be operated while charging during stage one. Please note though that supplemental loads will reduce the amount of amperage available to the battery. The charger detects that a battery is fully charged when its charging current drops below a preset limit in a specific elapsed time. The presence of electrical loads on the battery will interfere with this process. Therefore when the charger is in stage two-absorption charging it is necessary for the battery to be isolated from loads.

The **SMARTCHARGER** is in Stage 2 when the charge rate is declining.

- 2) Select the correct battery voltage.
- 3) Select the correct charging rate.(TurboStart 16V AGM battery should be charged at 15A when at the shop or 25A for rapid charging at the track.)
- 4) Connect the red positive (+) clip of the charger cables to the positive (+) terminal of the vehicle battery.
- 5) Connect the black negative (-) clip of the charger cables to a solid chassis ground. If this is not possible, connect it to the negative (-) battery terminal.
- 6) Flip the power switch on the front panel to ON.

The **SMARTprocessor** will analyze the battery and then after a short delay, the “Charging Status” indicator on the front panel will illuminate beginning the three-stage charging sequence. During charging, the charging current can be reset to a different charge rate if necessary.

⚠ CAUTION: Do not change the voltage type during charging. Use the correct battery type at all times.

During Stage 1, bulk charging, the amperage will begin at 20A. During Stage 2, absorption charging, the amperage will start to fall to zero as the battery comes up to 100%. After the charging process is completed, the “Charging” indicator light will go out and the Float Charge indicator will come on. During Stage 3, Float charging, the cooling fan inside the charger will stop and the battery can be left in this stage indefinitely.

*Note that the charger will automatically restart the charging sequence if the charge current rises above a factory preset threshold.

- 7) When complete, flip the power switch to OFF.
- 8) Remove the black negative (-) clip and the red positive (+) clip from the vehicle’s battery terminals.

- 1) Volt & AMP Output Display:** (Selectable) Indicates either voltage or amperage output of the charger. During Stage 1, “Bulk Charging”, amperage will display the selected charge rate. During Stage 2, “Absorption Charging”, this rate will naturally fall to zero as the battery percent of charge nears 100%. In Stage 3, “Float Charging”, the indicator will read close to zero.
- 2) Display Mode:** Allows the user to select displaying voltage and amperage. LED indicators illuminate when either voltage or amperage is selected.
- 3) Voltage Select:** Allows the user to select the appropriate battery voltage. LED indicators illuminate for either 12V(6cell), 14V(7cell), or 16V(8cell) batteries respectively.
- 4) Charging Rate:** Select 5A, 15A, or 25A as base rate for Stage 1 or bulk charging. In general, the rate should match the size of the battery.
- 5) Power Switch:** Illuminates when the input AC power is applied.
- 6) Charging Indicator:** Illuminates when the charger is in stage one bulk charging or stage two absorption charging.

⚠ CAUTION: It is important to select the correct battery type.



- 7) Float Charge Indicator:** Illuminates when the charger is in stage three or float charge mode.
- 8) Error Indicator:** Illuminates when the battery cannot be completely charged in a 10 hour period at the selected charge rate. Switch the charger OFF and remove the battery connections. Insure the battery polarity is correct, and if so, replace battery.
- 9) Fuse Holder:** Contains a 10A fuse in case of overload.
- 10) AC Cord:** Grounded 3-pin 110V(220V for “E” model) cord for use with grounded outlets only.
- 11) Battery Clamps and Cord:** Allow for connection to the battery.

Please read this chapter before calling Customer Service. If you cannot solve the problem with the **SMARTCHARGER**, record the information asked for on “Information About Your System” on the back page and then call Customer Service. Thank You.

⚠ WARNING: Electric shock hazard

Do not disassemble the **SMARTCHARGER**. The **SMARTCHARGER** does not contain any internal user serviceable parts and attempting to service the unit yourself could result in electrical shock or burn.

- Power light does not come on when the power switch is flipped ON:
 - Check fuse.
 - Check cord and input power.
- Voltage LED will not illuminate for 12V, 14V or 16V:
 - The battery is not connected.
 - The battery is below 4.0V.
- Charge rate does not come up to the selected charge rate initially:
 - The battery charger has already moved into stage two charging.
 - Input voltage is below 120VAC.
 - The battery may be defective and resisting the charge current.
- LCD Display Error Codes:
 - F01: The battery may be damaged and unable to accept charge.
 - F02: The battery did not reach the full voltage after 48 hours charge time.
 - F03: The battery is connected to the charger backwards.
 - F04: The charger is overheated. If the temperature exceeds 185°F/85°C, the charger will stop working for 30 minutes and restart automatically.
 - F05: The wrong voltage selected for the battery being charged.
- “Error” indicator is illuminated:
 - This illuminates when the battery cannot be completely charged in a 10 hour period at the selected charge rate

To reset this error, switch the battery charger OFF and remove the battery connections. Insure the battery polarity is correct. If you are charging a large battery at the 5A rate, try a higher charge rate. If the error persists, replace the battery.

Can I change the clamps on the charger with quick disconnects?

Yes. We recommend soldering all electrical connections where possible.

Can I run my electric water pump and cooling fan while charging?

Yes with a word of caution. There are two issues. First the charger will only provide 25A maximum charge current. Any amperage being consumed by extra electrical loads (ie. electric water pumps, etc.) will take away from the amperage available for battery charging. The battery charge time will be increased. In addition, the battery charger monitors the battery voltage and time to determine when the battery is at 100% charge. Extra electrical loads on the system will give the charger false information and therefore will prevent the charger from properly completing stage two.

Second, some electrical items can be damaged by high voltages. Data loggers, computers, and other items may lose data or be seriously damaged if subjected to the 19.0~20.0VDC of charging voltage. We do not recommend retrieving this information while charging. If in doubt about a particular component, consult with its manufacturer concerning its maximum input voltage.

⚠ CAUTION: Data loggers, computers of all sorts, and light bulbs may be damaged by the 19.0~20.0VDC of input voltage during charging. Do not operate these items while charging. We recommend disconnecting the battery from the system while charging.

Can I run this charger from a portable generator?

Yes with a word of caution. Since the output of the battery charger is directly proportional with the input voltage, we recommend portable generators with automatic voltage regulation. The **SMARTCHARGER** is calibrated at the factory assuming 120VAC, 60Hz or 230VAC, 60Hz. Deviations from these voltages will cause deviations in the output voltage and overall performance.

How many batteries can I recharge at one time with the SMARTCHARGER?

This depends on the size of the batteries. All batteries in the bank must be of the same type and size. In addition, the **SMARTCHARGER** is expecting the battery bank to be at full charge in 10hrs or less. Therefore the size of the batteries and their depth of discharge will play a role in the answer here. If you were charging all Turbo Start 16V AGM batteries with a size of 50Ah at 100% discharged, you can charge up to four in parallel in 10hrs.

Calculating External Battery Charging Time

Charging time will depend on the amp-hour capacity of the battery and its DOD. DOD, short for the Depth of Discharge, is used to describe how deeply the battery is discharged. If a battery is 100% fully charged, it means the DOD of this battery is 0%. If the battery has delivered 30% of its energy, there is 70% energy reserved, then the DOD of this battery is 30%. And if a battery is 100% empty, the DOD of this battery is 100%. DOD always can be treated as how much energy that the battery delivered. The following equation calculates an approximate charging time:

$$\text{Charging Time} = \frac{\text{CAP} \times \text{DOD}}{\text{CC} \times 80\%} \text{ where:}$$

$$\begin{aligned} \text{Charging Time} &= \text{Battery recharge time in hours} \\ \text{CAP} &= \text{Battery capacity in amp-hours} \end{aligned}$$

$$\begin{aligned} \text{DOD} &= \text{Battery depth of discharge in percent.} \\ &\text{A fully discharged battery has 100\% DOD.} \end{aligned}$$

$$\text{CC} = \text{Charge current. The rated current output of the charger in amps.}$$

$$80\% = \text{Typical charging efficiency for lead-acid batteries.}$$

Example:

A TurboStart 16V AGM battery rated at 50 amp-hours is 60% discharged, that is, it has a DOD = 60%. Charging time with an **SMARTCHARGER 15A** unit is calculated as follows:

$$\text{Charging time} = \frac{50\text{Ah} \times 60\%}{25\text{A} \times 80\%} = 1.3 \text{ hours (1 hour, 21 minutes)}$$

Warranty

We take great pride in our quality, value and performance and believe that this product should offer you trouble free operation throughout its lifetime providing you take care to follow the simple instructions in the product documentation.

If you experience any problems with your product, please read the warranty details listed below carefully.

Limited Warranty

TurboStart provides a one year warranty from the date of purchase, to the original purchaser. This warranty covers manufacturing defects in material and workmanship only.

TurboStart does not cover damage or failure caused by abuse, misuse, faulty installation, improper maintenance, or any attempted repairs not carried out by TurboStart.

There will be no obligations or liability on the part of TurboStart for consequential damages arising from the use of the product or any indirect damages with respect to loss of property, revenue, or costs for removal, installation, or reinstallation.

For warranty service, the product must be reported to TurboStart to receive a unique RGA number (return goods authorization) and at that time you will be advised of where to send the faulty product.

All shipping charges for returns should be prepaid. If the requested repairs or service are within the terms of this warranty then the item will be returned to you on completion without any charge. The unit must be in its original packaging with any original accessories. TurboStart will not be responsible or accept any liabilities for any loss or damage to additional items which are sent with returned product. If the product is not covered under the terms of this warranty Turbo Start will advise you of the costs to carry out any repairs necessary and the unit will be shipped to you on receipt of payment for the work including the return freight charges.

Please allow 2 to 4 weeks for return of your product. Under normal circumstance we try to ensure we carry out warranty repairs within 5 working days. We cannot be held responsible for delays in shipping.

Product

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY TURBO START IN CONNECTION WITH YOUR TURBO START PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY. IN NO EVENT WILL XS POWER BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING WHETHER IN CONTRACT INCLUDING WITHOUT RESTRICTION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, ANY PERSONAL INJURY, ANY DAMAGE OR INJURY ARISING FROM OR AS A RESULT OF MISUSE OR ABUSE, OR THE INCORRECT OPERATION OF THE PRODUCT.

Exclusions

If this product is a consumer product, federal law does not allow an exclusion of implied warranties. To the extent you are entitled to implied warranties under federal law, to the extent permitted by applicable law they are limited to the duration of this Limited Warranty. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply to you. This Limited Warranty gives you specific legal rights. You may have other rights which may vary from state to state or province to province.

TurboStart[®] BATTERIES

